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INDIA'S CALENDAR CONFUSIONS*

BY M. N. SAHA†

M. N. SAHA

OLDEST of astronomical problems is the calendar. Here indeed we have an indispensable requisite of civilized life, and the difficulties of working out a satisfactory time system are as ancient as the dawn of civilization. These were the necessities which first took primitive man into astronomy—because the primary natural time-markers are the sun, the moon and the revolving heavens.

To obtain a precise definition and determination of the natural cycles of time, primitive man had to make observations over long periods. Astronomy, the first of all the sciences, arose from these observations. Down through the ages the astronomers have devised hundreds of calendars, which have been used by different tribes, peoples and nations. Many of them have been discarded because they were based

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† President of the Astronomical and Astrophysical Society of India.

on insufficient knowledge. Others have undergone frequent changes, in efforts to make them adequate. None have been completely satisfactory, and the world is still seeking improvement.

As regards India, we find the existing situation chaotic and intolerable. Around the use of our somewhat numerous calendars there have grown up countless myths, religious dogmas, superstitions and astrological (and astrolatrical) practices which have profoundly damaged the cultural development of our people, and which urgently require liquidation.

Since A.D. 1200, the natural life of India has been paralyzed through astrology and foreign rule—but more through astrology than through alien government. We cannot afford to delay any longer the establishment of a new *National Calendar*, purged of astrological anachronisms and falsifications, a calendar which will gradually replace all the confusing local almanacs and thus prove not only a boon but also a great unifying factor in our country.

As we study this important project, it is clear we should use as our *basis* the proposals which have been internationally advanced by The World Calendar Association. They represent a far-sighted improvement on the current Christian[1] (or Gregorian) calendar, which is now used in a great part of the civilized world, but which in many ways is an extremely inconvenient and unscientific system of time reckoning.

[1]What is now known as the Christian calendar had originally nothing to do with Christianity. It developed by way of Rome and Egypt from the calendar of semi-savage tribes of Northern Europe, who started their year with the beginning of spring and had only ten months of 304 days, ending about the time of the winter solstice (25 December), the remaining 61 days forming a period of hibernation when no work could be done owing to the severity of the winter, and so this period was simply not counted. The city state of Rome took this calendar and made several corrections, including the division of the hibernation period into the months of January and February as the 11th and 12th months of the year. Julius Caesar after his conquest of Egypt introduced new corrections and refinements, including the leap-year principle. His calendar spread throughout the Roman Empire and survived the adoption of Christianity. But the Christians introduced their own religious holidays, which were partly Jewish in origin and complicated by the lunar aspects of the Jewish calendar.

The seven-day week was imposed on top of the Roman pattern by Emperor Constantine, and proved an awkward complication which only now is on the way to adjustment through the changes proposed in The World Calendar. (In order to make the calendar perpetual, at the same time retaining its astronomical accuracy, the 365th day of the year will be left outside the weekly cycle and called Worldsday. In leap years, the same treatment will be used at mid-year for the extra 366th day. With this ingenious device, and a slight correction in the lengths of the months, The World Calendar makes the year divisible into equal halves and quarters. Every year is the same, every quarter identical.) In India the weekday was unknown to the ancient indigenous systems of time reckoning: it must have migrated to India in the wake of Greco-Chaldean astronomy and astrology.

Let me say, at this stage, that we astronomers as professional men must do more than merely suggest the wisest measures of reform. If we want these measures to be adopted and to endure, we must also propose methods whereby the Indian people generally will be induced to approve the change and to abandon their old and ingrained astrological practices. It is a simple lesson of history that only dictators like Julius Caesar or religious leaders like Mohammed[2] and Pope Gregory wield the power to *impose* such measures of reform. We should remember that although the Greeks produced the greatest astronomers of ancient times, these talented gentlemen could do nothing to remedy the calendar confusion around them: the city states of Greece employed nearly a hundred different calendars, and because there was no central authority to compel the use of a single system, this confusion went on interminably until Roman conquerors came and forced everybody to conform to their absurd and unscientific Roman system.

In our country, then, the mere enactment of an all-Indian National Calendar is not sufficient, for it may become a dead-letter (as happened in the case of the well-intentioned calendar reform measure of our Emperor Akber[3] in the 16th Century) unless there is a living organization to work out details, to carry on a persistent educational propaganda program, and to keep the government aware of the usefulness of the new system and the harmfulness of the old.

This is one of the reasons why we propose to combine our recommendations for calendar reform with proposals already under way for an Indian Greenwich, a national observatory to be located in the central part of the country, which will have a competent staff of astronomers to compile an annual calendar and place it officially before the nation yearly.

[2]The purely lunar calendar still used by Islamic countries was introduced by the prophet to release his followers from dependence on the learned Ulema (doctors-of-the-law) for finding out the time of religious observances. The lunar year, starting with the month of Muhurrm, may begin on any date of the solar year, and the Mohammedan year slips through the solar year in 32½ years. This complete severance of the year from the seasons has been found very inconvenient.

[3]In Iran, the great Sultan Melik Shah of the Seljuk dynasty, introduced the Jelali solar calendar in 1079, and this achievement was brought to India in 1584 by Emperor Akber. After a few decades it fell into disuse, but it gave rise to a number of hybrids like the Bengali "San" and the Fasli eras which are still current in parts of India. The Jelali calendar is one of the best solar calendars, as it takes into account the precession of the equinoxes and gives a better approximation of the actual tropical year than even the Gregorian rules. Akber's reform measure was misunderstood and in the absence of central guidance became combined with ancient errors. Further, it took on local colour in various places and the very purpose of introducing a national calendar was defeated. But it was a worthy attempt, the greatness of which should be properly appreciated.

A National Observatory, entrusted with the task of producing not only an annual calendar, but also an Indian Ephemeris and Nautical-and-Air Almanac, will be a great and useful institution. It is true that the British and American Ephemeris are now internationally accepted undertakings, but an Indian version with the proper local modifications and using Indian nomenclature, will be of great utility and cultural value, not only for the Indian naval and merchant marine and for the Indian Air Force and commercial air lines, but also for the whole civilization of our country.

In this connection let me point out again that astronomy came into existence for the purpose of satisfying an elemental need of civilized life. It has stimulated human enterprise along very fruitful lines, and has proved to possess the highest utilitarian and cultural value through the ages. In India more than a thousand years ago, the influx of Greco-Chaldean astronomy led eventually to the formulation of the calendar systems we still follow, and it led also (between A.D. 300 and 1200) to original contributions by famous Indian scholars to astronomy, geometry, trigonometry and algebra. This flood of cultural activity was unfortunately accompanied by a cancerous growth of astrological fantasy,[4] which ultimately choked the spirit of free scientific inquiry and left our people victims of the hallucinations and inventions of astrologers. This development had very unhappy consequences for India—from which we are still suffering. It was because of such false doctrine that we lost our place in scientific progress, and the cultivation of astronomy moved into the hands of the virile Islamic nations, whose capable scholars made substantial contributions to observational astronomy and nomenclature and classification of stars.

The world-wide conflict between scientific astronomy and fantastic astrology went on throughout the middle ages. A great period of astronomical advance began with the Renaissance. Copernicus gave the world his theory of the solar system. Kepler discovered the laws of planetary motion. Galileo invented the telescope and enunciated the laws of dynamics. To meet the needs of navigation and scientific inquiry, national observatories were founded in Paris, London, Berlin, Rome, St. Petersburg and other western cities.[5]

[4]Today in India, for the determination of the "propitious" date and moment for all sorts of activities and observances, the people are entirely dependent on astrologers, who pretend to possess the knowledge to produce such information from the ancient formulas. . . . The dates and moments of auspicious days are given by different combinations of ancient astrological elements, for which it is not possible to find any scientific justification.

[5]Prototype of modern observatories was that founded by the Danish genius Tycho Brahe in 1576. The telescope came along in 1609, and the first of the new kind of

This period culminated with Newton and his law of universal gravitation, which explained planetary motion and the precession of the equinoxes. When Newton was asked why he chose astronomy for his life work, he replied that he wanted to find out whether astrology had any rational basis. Astrology was then the common name for what we now call by two names—Astronomy and Astrology.[6] But scientists were beginning to realize the spurious nature of the latter, with its practice of casting horoscopes and foretelling the future from the position and motion of the planets. Newton's discoveries smashed the foundations of the false science by showing that the position of planets and the peculiarities of their motion were simply the result of universal gravitation and had no bearing on human activities.

About the same time, Edmund Halley made his observations of the comet which has since borne his name. Comets appear from nowhere and on account of their weird appearance had always been taken to portend some great calamity. Halley figured from ancient records that the comet of 1681 had appeared on three earlier occasions at intervals of 76 years, and he calculated from the Newton theory that it had a very long elliptic orbit and would re-appear at intervals of 76 years. His deduction that comets obey the law of universal gravitation proved that these heavenly visitors could no longer be interpreted by astrologers and soothsayers as an indication of divine displeasure at man's wickedness.

Around 1774 William Herschel, an amateur astronomer, began to view

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observatory was that used by Galileo in Padua in 1610. Next came the Tower of the Winds, established at the Vatican by Pope Gregory, the calendar reformer. Paris national observatory dates from 1667, Greenwich from 1675. In the United States, the Washington national observatory was founded in 1843.

[6]Though astrology has proved very harmful, it is doubtful whether without this astrological stimulus, leaders of early civilizations would have paid any attention to the cult of star-gazing, which in all ages has been regarded, superficially enough, as a subject of no practical utility . . . Whatever the motive, we owe to the Chaldean astronomers the accurate determination of the periods of the sun, the moon and the planets, and peculiarities of their motion, the discovery of phenomena like the precession of the equinoxes, and the evolution of a mathematical symbolism to express these discoveries. But after 100 B.C., the Chaldeans degenerated into professional astrologers, who were highly prized by the superstitious Romans for the casting of personal horoscopes and fortune-telling, a practice resented by great leaders of Roman thought like Cicero and Seneca as leading to national degeneracy. The torch of astronomical science passed to the Greeks, who freed themselves of the idea that planets were gods, but regarded them as mere material bodies subject to some laws which they tried hard to discover, and came very near doing it. Through the Greeks the knowledge of astronomy and astrology passed to the Roman Empire. But Roman contribution to astronomy was almost nil, and the people of Europe, newly converted to Christianity, paid more attention to astrology than to astronomy.

the heavens with telescopes of his own making which were much more powerful than anything previously manufactured. He discovered double stars, and found many of them going around each other according to the law of universal gravitation. Half a century later, instrumental techniques had developed so far that the distances of stars could be measured, and then for the first time the immensity of space was brought home to mankind. It takes light nearly four years to reach us from the nearest star, as contrasted with eight minutes from the sun, and now astronomers are measuring characteristics of stars millions of light-years away. Each of the stars is in fact a sun, mostly larger than ours, and possibly possessing planets in attendance. There is no reason why some of these planets should not be inhabited, and thus astronomy has blown away the myth of man's preferential position in the Universe, which has been the basis of much astrological and religious doctrine.

A century ago, astronomy appeared to have reached a rather sterile phase, when it seemed there was not much more for the astronomer to do. But the development of photography and of spectrum analysis put new life in the old frame. Suddenly the new science of astrophysics opened vast horizons of knowledge. The Americans, with their huge material resources, enthusiasm and mechanical skill, took the lead and their great observatories became the envy and wonder of the Old World.

Indian astronomy, after a long period of paralysis due to astrological reasons, has lately made some significant progress in astrophysics. The first successful physical interpretation of the spectra of the sun and the stars, which had been accumulating for sixty years, was made on Indian soil about 32 years ago, and was hailed by Sir Arthur Eddington as "one of the ten great events in astronomy since Galileo." This event gave a tremendous stimulus to astrophysical studies all over the world—studies which have since been enriched by the labours of Chandrasekhar in America, Kothari at Delhi, Banerjee at Allahabad and Sen at Calcutta. Our Indian scientists have done their best, but they do not yet have any observatory or laboratory where they can turn for practical and observational work on their theories. Many of our best men are getting a welcome asylum abroad.

India has so far only two observatories worth the name—Kodaikanal and Hyderabad. No Indian university has any observatory of importance. I hope sincerely that this situation will soon improve. Pursuit of astronomical studies is investigation of Nature on a scale unattainable on the earth, for on account of the wide variety of physical conditions, phenomena are taking place in space which we cannot reproduce on our planet. Such knowledge as astronomy brings us has always fertilized the

human brain and led it into fresh fields of enterprise. And now to return to the problem of an all-India National Calendar. Our analysis of the situation suggests the following objectives:

1. *All calendar calculations should be made for an Indian Greenwich to be located in the central part of India.* At the present time, certain calendar elements are fixed by rules which are different in different parts of the country. In other words, calculations of "auspicious" days may be correct for one locality but incorrect for another. The question is: Are all these complex rules needed for personal welfare or national interest? Analysis shows that the rules are all consequences of luni-solar adjustment, and are purely mathematical in origin. They cannot have the mystic meanings attached to them by astrologers. All days and moments are otherwise equally good, and the more one examines the matter, the more one is convinced that the idea of auspicious and inauspicious moments is a mere figment of the imagination.

2. *Days should be calculated in the accepted astronomical manner, from midnight to midnight of Indian Greenwich.* At present, the Hindu civil day is figured from sunrise to sunrise, in contrast to the Jewish method of considering a day as the period between sunset and sunset. Throughout India many calendar calculations are made by way of "tithi" or lunar days. Historically these tithi have sometimes been figured from moonset to moonset, sometimes from moonrise to moonrise. By strict mathematical definition they represent one thirtieth of the lunar month, beginning from the moment when conjunction of the moon with the sun is completed. They are enumerated by numbers; the first, second, third, etc.

3. *The astrological elements in our present system should be abandoned (as far as the official government calendar is concerned) and the calendar made simpler and applicable to all parts of India.* It may be left to the Panchang-makers (publishers of popular almanacs containing astrological data), to frame their lunar calendars,[7] but lunar calendars should be avoided for all civil purposes as far as practicable.

4. *It will be desirable from an astronomical viewpoint to start the year at the vernal equinox or winter solstice.* In India there have been 25 different kinds of calendars, some of which are now extinct. If we

[7]The word Panchang literally means "five-legged calculations," so-called because they supply five different astrological elements which are used to calculate auspicious and inauspicious days and moments for various human enterprises and religious observances. These five elements are: 1. The Vara or weekday; 2. The Tithi or lunar day; 3. The Karan or half lunar-day; 4. The Nakshatra, or stellar situation surrounding the moon on each day; 5. The Yoga, a complicated division of the lunar month into 27 segments.

leave aside the variant year-beginning and the era-beginning, all the calendars now current in India employ almost identical rules of time-reckoning. To be precise, three different systems are now in use, which differ slightly. They are all based on the solar calendar, which serves as the door post to which the lunar calendar is hinged. It is the lunar calendar which determines the right date and moment for undertaking various enterprises and religious observances. This emphasis on moments (Muhurtas) is what gives our calendars their distinctive stamp. It appears that our ancient astronomers were actuated by the motive of defining everything in a very precise and mathematically accurate manner, but this had the effect of making the calendar extremely, and I think unnecessarily, complicated. . . . For a sound year-beginning, all of the four cardinal points of the year (Vernal Equinox, Summer Solstice, Autumn Equinox and Winter Solstice) have been used at various periods[8] by ancient calendar-makers: but as time passed, their year-beginning has always tended to become artificial, owing to errors in the rules or other causes. For example, 1 January, which is the year-beginning in the Roman-Christian calendar, appears originally to have been the Winter Solstice Day in 750 B.C., but it lost all connection with that point of anchorage because the Romans had no idea of the correct length of the year.

5. *Year length shall be 365.2422 days.*

6. *The present irregular months shall be given up in favour of the lengths proposed by The World Calendar.*

In pursuit of these objectives, we make the following observations on the basis of our study of foreign and Indian calendars:

A. The so-called "Christian" calendar, now used in most parts of the civilized world, is an inconvenient and unscientific instrument.

B. Indian calendars are in an extremely confused state, partly because they follow systems laid down 1,400 years ago; thus the calculation of

[8]The autumn equinox was the starting point of the year in the short-lived calendar of the French Revolution (1792). This remarkable calendar, with its ten-day weeks and its five or six year-end days, was devised by the great mathematicians Laplace and Lagrange and the poet Fabre d'Eglantine (Fabre of the Wild Rose). It never gained much recognition even in France outside of Paris, and was abandoned after a short course of 14 years by Napoleon, as a condition for his recognition by the Roman church.

Astronomers have pointed out that the first of January has a certain scientific basis for the year's beginning. On or about 1 January, the earth is at its shortest annual distance from the sun, about 91,500,000 miles; whereas six months earlier, when the sun is farthest away, it is at a distance of approximately 94,500,000 miles. It follows from this that on the day in January which marks the earth's perihelion, our planet also receives the greatest amount of solar heat. It has been computed that the earth receives 10 per cent. more heat at that time than it does at the beginning of July.

seasons is wrong by 24 days, and the length of solar months followed by the almanac makers violates the fundamental rules of scientific astronomy.

C. It is difficult to work out a convenient scheme of months according to the 1400-year-old rules. This effort should be given up in favour of the proposals of The World Calendar Association.

D. The National Government of Free India should not allow such an important and unifying item of life as the calendar to remain in its present confused state. A National Calendar, based on proper solar time reckoning, should be devised for the whole of India.

E. The private almanac makers, who publish the astrological data required by the people of India, should be left to frame their own lunar calendar and peg it to the official National Calendar as they wish; but lunar calendars should be avoided for all civil purposes as far as practicable.

F. The Indian Government should construct an astronomical observatory at a convenient central point and attach to it a body of expert astronomers whose duties should include the annual compilation of an Indian Ephemeris and Nautical-and-Air Almanac and a National Civil Calendar.

THREE MOST INTENSE SOLAR NOISE BURSTS ON A WAVE-LENGTH OF 10.7 CENTIMETRES

By A. E. Covington*

Abstract

The three most intense solar noise bursts recorded on a wave-length of 10.7 centimetres at Ottawa are shown graphically. These are from a collection of 432 bursts which occurred during 11,700 hours of observations in the years 1947 to 1952 inclusive. In each case the peak flux is greater than 1.7×10^{-19} watts/m.^{2}/cyc./sec.

Every sun-spot cycle presents solar phenomena of exceptional magnitude such as large sun-spot groups, intense flares and extensive prominences. Similarly, in the radio spectrum exceptional bursts of solar noise on a wave-length of 10.7 centimetres have been observed at Ottawa in the laboratories of the National Research Council. These bursts are unique in that the peak intensity is very great. They occur unexpectedly, and because of their magnitude, present definite problems in that the receiver sensitivity must be reduced considerably in order to find the maximum intensity. Observations were commenced in 1947, and at the end of 1952, 11,700 hours of observations revealed a total of 432 solar noise bursts. An indication of the frequency of occurrence of all bursts on 10.7 centimetres can be seen in figure 7, in a paper titled, "Some Characteristics of 10.7-Centimetre Solar Noise".[1]

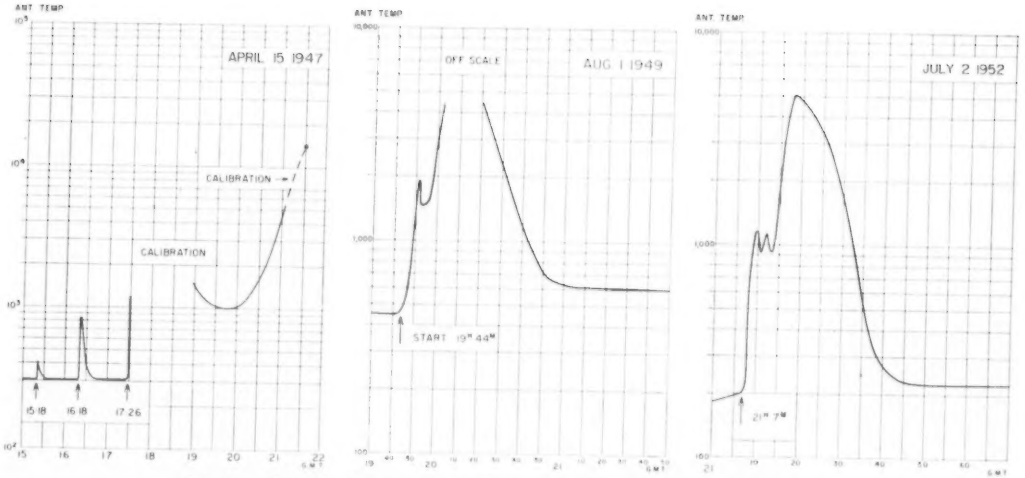
Three of the bursts are exceptionally intense, with an intensity greater than 1.7×10^{-19} watts/m.^{2}/cyc./sec. Reconstruction of the intensity variations with the fine structure necessarily omitted are shown in the accompanying figures. Numerical values are summarized in Table I; figures in parentheses are estimated.

During the burst on April 15, 1947, the reduction of gain with subsequent recalibration was done manually from 1800 hours to 1900 hours.

TABLE I

Date	Antenna Temperature °K.		Flux watts/m.^{2}/cyc./sec. $\times 10^{-20}$	
	Burst	Daily Level	Burst	Daily Level
April 15, 1947	> 12,000	(300)	> 52.0	(1.29)
August 1, 1949	> 4,000	455	> 17.2	1.96
July 2, 1952	4,800	185	20.6	0.80

*Radio and Electrical Engineering Division, National Research Council, Ottawa, Canada.



Intense solar noise bursts, recorded on a wave-length of 10.7 centimetres.

and again from 2100 hours to 2130 hours. Afterwards the radiometer was turned off. The error in reading such high equivalent temperatures of the antenna radiation resistance is considerable, and for this burst may be ± 25 per cent. The equivalent temperature of the antenna radiation resistance (12,000°K.) has been quoted before,[2] and is so high that some doubt about its reality has been raised.[3] This temperature of the antenna radiation resistance is equivalent to raising the temperature of the whole solar disk (at the radio wave-length of 10.7 centimetres) to a value of 3×10^6°K., and when further considerations are given to the smaller size of the flare, exceptionally high equivalent temperatures are obtained: of the order of 10^9°K. Two other bursts of similar intensity have been observed subsequently, one on August 1, 1949, and the other on July 2, 1952.

The burst on August 1, 1949, was recorded on a special channel provided with low sensitivity. The error in this reading is less—about ± 10 per cent.

On July 2, 1952, a special channel had been provided with an automatic reduction in receiver sensitivity for instances when the burst intensity exceeded a certain level. Such a device allows adequate recording of the small bursts as well as the larger ones. The error in reading is about ± 10 per cent.

These intense solar noise bursts are associated with radio fade-outs. Undoubtedly a chromospheric eruption or flare on the solar surface occurred at the same time as each burst, but only reference to the one on April 15, 1947, has been found.[4]

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THE SPECTRUM OF NOVA SCUTI 1949

By John F. Heard

Fifteen single-prism spectrograms of Nova Scuti 1949 were obtained at the David Dunlap Observatory between August 13 and September 16, 1949. The spectrograms extended from 3900 A. to 5100 A. with dispersion 66 A./mm. at Hγ. A preliminary report of measures of these with particular reference to the radial velocities yielded by the principal absorption spectrum was made by the writer[1] in 1950. Further studies of the spectrograms have now been made with particular reference to absorption line identifications and the development of the spectrum during the interval covered. Other reports on the spectrum of this nova include those of Kourganoff, Canavaggia and Muench,[2] Colacevich,[3] Wellmann,[4] and Andrillat and Fehrenbach.[5]

Our first observation of the spectrum was made on August 13 which was seven days after maximum light according to Wellmann's determination of the time of maximum.[4] At that time the main features of the spectrum were broad emission bands of hydrogen and of ionized iron and many fairly sharp absorption lines due mostly to ionized metals. Changes were mostly confined to the structure of the hydrogen lines and the appearance of lines attributed to the "Orion-stage" spectrum.

The structure of the hydrogen lines was complex, and to some extent it was marked by the superposition of absorption lines from other elements; this was especially true at Hγ. However, from a careful study of Hδ, Hγ and Hβ throughout the series of observations the following interpretation has been made. The main part of the emission extended on the redward side to about + 860 km./sec.; towards the violet this main part was limited by strong absorption structure, sometimes double, which showed velocities of about − 315 and − 550 km./sec. The main emission feature was not uniform in intensity; in the beginning it showed two rounded maxima of intensity and, as time went on, the maximum to the red of centre grew much stronger, until at the end of the series it gave the appearance of a sharp emission peak which was located at + 575

km./sec. Other emission lines (principally FeII) shared this structure which no doubt represented the development of a jet of material on the far side of the Nova. On either side of the main emission extended a fainter wing; towards the red this extended to about + 1550 km./sec., and this faded progressively up until August 25, after which it became strong again and extended to about + 1775 km./sec. The corresponding wing on the violet side was considerably weaker and was limited up until August 25 by a weak, diffuse absorption line which showed a displacement of about — 1150 km./sec., and after that it was limited by a diffuse absorption line showing a velocity of about — 1900 km./sec. The violet emission wing and the associated absorption lines were seen best at Hβ.

Up until August 30 the hydrogen absorption structure of low velocity appeared to consist mostly, if not altogether, of a component of — 550 km./sec. velocity; after this some interesting changes developed. At Hδ, up until August 30, the absorption was so diffuse and on such a feeble background that it was not possible to obtain velocities with confidence or to say whether one or two lines were present; one can only say that absorption was present and that the velocity represented by it was not less than 300 km./sec. At Hγ there appeared, up until September 2, a strong component with measured velocity averaging — 535 km./sec. The position of this coincided almost exactly with the position of TiII 4337.92 displaced by — 360 km./sec., which was the velocity shown by other absorption lines of ionized metals; it is assumed that the line observed was a blend of Hγ and this TiII line. At Hβ a single low-velocity absorption line was measured throughout the whole series of plates, the mean velocity being — 556 km./sec.

On the plates of September 2, 3, 10 and 16 the structure of Hδ and Hγ underwent the changes shown in Table I. The new component at — 330 km./sec. developed at Hδ earlier than at Hγ and, apparently, had not yet begun to develop at Hβ on the last plate. The development of this component of smaller velocity was very marked at Hδ on the final plate of September 16; it was then the strongest absorption line in the spectrum by far, and there was no sign of the other component.

Speaking now of the higher-velocity components of the hydrogen lines, on most of the plates I have measured at Hγ a fairly strong absorption feature at positions which give a mean velocity of — 1065 km./sec. if the feature is to be attributed to hydrogen. The only alternative identification seems to be a blend of the TiII lines 4330.26 A. and 4330.71 A. which would not be expected to be as strong as the observed feature. At Hβ the component measured at — 1150 km./sec., which has already been referred to, may be the same as the —1065 km./sec.

component at Hγ; the CrII line at 4848.24 A. may blend with this Hβ component. At Hδ I found no evidence of the — 1065 km./sec. component.

TABLE I

MEASURED RADIAL VELOCITIES (KM./SEC.) OF LOW-VELOCITY COMPONENTS OF Hδ AND Hγ

Date	Hδ	Hγ
1949 Sept. 2	−573 strong −277 weak	−566 very strong
3	−492 very strong −268 weak	−577 strong
10	−499 weak −331 strong	−536 strong −334 weak
16	−330 very strong	−548 weak −344 strong

To sum up the hydrogen absorption components: a strong component at — 550 km./sec. persisted at Hβ and Hγ and probably at Hδ until August 30; beginning on September 2 another component at — 315 km./sec. appeared with the — 550 km./sec. component and finally seemed to be replacing it at Hδ and Hγ, not simultaneously but earlier at the former; a fairly strong component at — 1065 km./sec. was measured throughout the series of plates at Hγ and this may be the same as an Hβ component measured at — 1150 km./sec. A component of Hβ at — 1900 km./sec. appeared about August 26 and persisted.

Turning now to lines of other elements, there were many emission lines which were similar in structure to the hydrogen emissions, the strongest ones showing the same peak to the red of centre. These were difficult to sort out on the plates due to overlapping, but it was clear that the FeII spectrum accounted for the strongest of them, notably 4923.92 A., 5018.43 A. and 5169.03 A. which compared in intensity with hydrogen emission. The absorption lines accompanying the FeII emission were very weak by comparison with absorption lines of TiII and other ionized metals which, on the other hand, showed little or no emission.

The many, relatively sharp absorption lines are interpreted as constituting what McLaughlin calls the principal spectrum. They are due mostly, if not entirely, to ionized metals. They showed a displacement of about — 365 km./sec. The only lines, besides the hydrogen lines, which showed definite complex structure were the CaII *H* and *K* lines

TABLE II

MEASURED WAVE-LENGTHS AND IDENTIFICATIONS OF LINES OF THE PRINCIPAL ABSORPTION SPECTRUM

Wave-length	Int.	Identification	Wave-length	Int.	Identification
3933.5	7	CaII 3933.66, (400), 1	4148.3	2	ZrII 4149.22, (75), 41
3935.2[g]	1	———	4152.3	2	LaII 4151.98, (250), 40
3942.2	0	CeII 3942.15, (125), 37			LaII 4152.78, (100), 78
3944.2	1	CeII 3943.88, (100), 234	4154.5[g]	0	———
3948.2	1	LaII 3949.10, (600), 41	4157.8	2	———
3952.3	3	VII 3951.97, (500), 10	4161.1	4	ZrII 4161.20, (20), 42
3958.4	3	ZrII 3958.24, (50), 16			SrII 4161.80, (30), 3
3967.5	7	CaII 3968.47, (350), 1	4164.1	5	TiII 4163.64, (40), 105
3982.3	2	TiII 3982.00, (tr), 11	4168.2[g]	—	———
3996.5	2	VII 3997.13, (200), 9	4172.6	4	TiII 4171.90, (30), 105
4002.9	3	VII 4002.94, (80), 9			FeII 4173.45, (8), 27
		CrII 4003.33, (25), 194	4178.5	3	FeII 4178.86, (8), 28
4012.6	1	TiII 4012.37, (4), 11	4182.8	2	VII 4183.43, (250), 37
4020.0	0	———	4189.3	1	TiII 4190.29, (1), 21
4023.3	1	VII 4023.39, (600), 32	4195.5	2	LaII 4196.55, (250), 41
4028.2	0	TiII 4028.33, (7), 87	4199.2	2	CeII 4198.67, (75), 7
4032.5	1	LaII 4031.70, (300), 40			CeII 4198.72, (60), 3
4053.7	2	TiII 4053.81, (3), 87	4202.2	2	VII 4202.34, (150), 25
4061.8	2	CeII 4062.22, (60), 34	4208.6	0	ZrII 4208.99, (30), 41
4064.6	1	VII 4065.07, (100), 215	4211.6	2	ZrII 4211.88, (12), 15
4067.4	2	LaII 4067.39, (100), 26	4215.0[f]	3	SrII 4215.52, (300), 1
		NiII 4067.05, (3), 11	4221.7	1	CeII 4222.6, (300), 36
4070.9	3	CrII 4070.90, (10), 193	4224.3	0	CrII 4224.85, (20), 162
4074.0	0	CeII 4073.49, (300), 4			VII 4225.23, (120), 37
		CeII 4075.85, (125), 246	4227.8	2	CaI 4226.73, (500), 2
4077.7[f]	5	LaII 4077.35, (300), 41	4232.9	3	VII 4232.06, (80), 225
		SrII 4077.71, (400), 1			FeII 4233.17, (11), 27
4082.3	2	CeII 4081.22, (150), 4			CrII 4233.25, (10), 31
		CeII 4083.23, (200), 60	4237.3	1	LaII 4238.38, (400), 41
4086.1	2	LaII 4086.72, (300), 10	4241.8	3	CrII 4242.38, (30), 31
4093.5[g,h]	0	———	4246.5[f]	6	ScII 4246.83, (100), 7
4099.8[h]	2	LaII 4099.54, (150), 78	4252.0	1	CrII 4252.62, (10), 31
4110.5	2	CrII 4111.01, (18), 18, 26			CeII 4253.36, (50), 77
4112.9	1	CrII 4113.2, (5), 18	4256.2	1	CrII 4256.16, (5), 192
4117.2	0	CeII 4117.01, (75), 35	4261.9	3	CrII 4261.92, (20), 31
		CeII 4117.29, (20), 77	4265.0	2	LaII 4263.59, (200), 84
4129.5	3	CeII 4127.37, (150), 4	4268.6	0	CrII 4269.28, (10), 31
		CeII 4130.71, (100), 209			LaII 4269.50, (300), 76
4132.3	3	CrII 4132.41, (7), 26	4271.1	1	FeII 4273.32, (3), 27
4133.8	3	CeII 4133.80, (500), 4	4275.6	2	CrII 4275.57, (30), 31
4137.8	2	CeII 4137.65, (400), 2			LaII 4275.64, (100), 40
4142.5[g]	1	LaII 4141.73, (200), 40	4279.1	1	VII 4278.89, (60), 225
4144.6	2	CrII 4145.77, (25), 162	4289.6	5	TiII 4290.22, (50), 41

[g] These lines become stronger on later plates.

[f] These lines become much fainter on later plates.

[h] These may be components of hydrogen lines.

TABLE II (*Cont'd.*)

Wave-length	Int.	Identification	Wave-length	Int.	Identification
4294.5	3	TiII 4294.10, (40), 20			TiII 4443.80, (50), 19
4300.4[f]	2	TiII 4300.05, (60), 41	4450.6	4	TiII 4450.49, (10), 19
		VII 4301.13, (40), 225	4461.0	3	CeII 4460.21, (400), 2
4302.5	2	TiII 4301.93, (15), 41			ZrII 4461.22, (10), 67
		FeII 4303.18, (8), 27	4464.2	3	TiII 4464.46, (1), 40
4307.1	3	TiII 4307.90, (40), 41			VII 4464.32, (40), 199
4313.6	5	TiII 4312.86, (35), 41	4468.6	5	TiII 4468.49, (50), 31
		ScII 4314.08, (60), 15	4475.3	2	VII 4475.70, (20), 199
		TiII 4314.98, (40), 41	4480.5	3	MgII 4481.23, (100), 4
4320.7[f]	4	ScII 4320.74, (50), 15	4483.8	0	CeII 4483.90, (100), 3
4324.8[f]	4	ScII 4325.01, (40), 15	4488.9	5	TiII 4488.32, (15), 115
4334.3	3	LaII 4333.76, (500), 24	4495.4	0	ZrII 4496.96, (15), 40
		LaII 4334.96, (100), 77	4501.0	6	TiII 4501.27, (40), 31
4339.0	7	TiII 4337.92, (50), 20	4508.0	2	FeII 4508.28, (8), 38
4344.3	2	TiII 4344.29, (2), 20	4511.4	2	VII 4512.72, (60), 212
4347.1	2	FeII 4347.57, (4), uncl.	4517.9[f]	3	———
4350.9[f]	4	TiII 4350.83, (1), 94	4523.4	0	FeII 4522.63, (9), 38
		FeII 4351.76, (9), 27	4527.9	1	LaII 4526.12, (200), 50
4361.0	2	FeII 4361.25, (2), uncl.			VII 4528.51, (300), 56
4363.1[g]	0	LaII 4363.05, (50), 133	4534.5	5	TiII 4533.97, (30), 50
4367.9	8	TiII 4367.9, (15), 104	4541.3	2	FeII 4541.52, (4), 38
4371.6[f]	3	ZrII 4370.96, (8), 79	4545.5	1	TiII 4545.14, (tr), 30
4374.7	5	ScII 4374.46, (40), 14	4549.8[g]	4	FeII 4549.21, (4), 186
		TiII 4374.82, (1), 43			FeII 4549.47, (10), 38
		VII 4374.94, (300), 13			TiII 4549.62, (60), 82
4378.7[g]	0	LaII 4378.10, (50), 77	4557.9[g]	2	CrII 4558.66, (100), 44
		ZrII 4379.78, (9), 88			LaII 4558.40, (200), 39
4381.8	2	CeII 4382.17, (200), 2	4563.5	3	TiII 4563.76, (30), 50
4386.6	4	FeII 4385.38, (7), 27	4572.2	4	TiII 4571.97, (50), 82
		TiII 4386.86, (10), 104	4576.1[g]	0	FeII 4576.33, (4), 38
4391.2	0	TiII 4390.98, (1), 61	4579.7	2	ZrII 4579.78, (9), 88
4395.0	6	TiII 4395.03, (60), 19	4583.5[g]	3	FeII 4583.83, (11), 38
4400.6	2	TiII 4399.77, (35), 51	4590.2	3	TiII 4589.96, (2), 50
4404.0[g]	0	———	4613.6[f]	4	LaII 4613.38, (200), 50
4408.3	1	TiII 4407.68, (1), 51	4618.4[f]	6	CrII 4618.83, (35), 44
		VII 4408.9, (40), 224			LaII 4619.87, (300), 76
		TiII 4409.22, (tr), 61	4642.7	0	———
		TiII 4409.52, (tr), 61	4645.7[f]	3	LaII 4645.28, (100), 8
4411.7	4	TiII 4411.08, (15), 115	4760.0	3	TiII 4762.77, (1), 17
		TiII 4411.94, (1), 61			CI 4762.4, (4), 6
4417.2[f]	7	TiII 4417.72, (40), 40	4771.5	2	CI 4771.72, (4), 6
4422.5	1	TiII 4421.95, (1), 93	4790.0	3	———
4428.0	1	MgII 4428.00, (7), 9	4824.7	3	LaII 4824.05, (100), 50
4435.1	4	CaI 4434.96, (60), 4			CrII 4824.13, (75), 30
		CaI 4435.69, (40), 4	4837.4[h]	2	CrII 4836.22, (25), 30
4443.7	8	ZrII 4442.99, (25), 88	4846.8[h]	2	CrII 4848.24, (60), 30

[g]These lines become stronger on later plates.
[f]These lines become much fainter on later plates.
[h]These may be components of hydrogen lines.

which each had a component at about — 900 km./sec. as well as the one at — 365 km./sec.; these could be measured only on a few well-exposed plates. Table II gives the wave-length measures (corrected for the velocity displacement), the estimated intensities and the identifications of the lines of the principal absorption spectrum. The intensity estimates are those made from a particularly good plate of August 16; generally speaking, the lines become less intense on later plates. As regards the identification, the number in parentheses following the wave-length is the intensity listed in Miss Moore's Multiplet Table[6] and the number following that is her multiplet number. It is seen that the spectrum most abundantly represented is TiII; by comparison there are few lines of FeII. This anomaly has been a characteristic of other nova spectra. Also represented with certainty are the spectra LaII, VII, SrII, ZrII, CrII, ScII, CeII, MgII, CaI, CaII and CI. The identification of a few lines of FeI is regarded as doubtful.

The velocities determined from the best of the ionized metal lines in the principal spectrum are given in Table III. These velocities show a remarkable constancy over the period involved; most nova spectra, in as long an interval, show an appreciable acceleration of the expanding shell.

The most noteworthy change in the spectrum during this series of

TABLE III

RADIAL VELOCITIES FROM THE PRINCIPAL ABSORPTION SPECTRUM

Date	Velocity (km./sec.)	Number of Lines	Prob. Error
1949 Aug. 13	−392.8	27	3.7
14	−381.2	24	4.5
15	−369.2	24	4.9
16	−372.9	39	2.4
19	−372.4	24	2.9
20	−364.6	30	4.3
22	−378.8	33	3.2
23	−375.1	23	3.4
25	−368.2	27	4.0
26	−369.3	30	3.4
30	−383.6	22	4.5
Sept. 2	−365.9	15	3.6
3	−369.6	27	3.7
10	−360.1	21	3.8
16	−352.4	19	3.5

plates was the development of new emission and absorption in the neighbourhood of 4640 A. Appearing first on August 22 and increasing in intensity until the last plate on September 16, there was a broad emission band which had its centre at 4657 A. and extended from 4632 A.

to 4682 A. On the later plates this band developed a fairly sharp maximum at 4653 A., and a less sharp one at 4671 A. If we assume that these maxima were produced in the same way as the emission peaks of the hydrogen lines with displacements corresponding to a velocity of + 575 km./sec., then we get 4644 A. and 4662 A. as estimates of the wave-lengths responsible for these maxima. These wave-lengths agree pretty well with the strongest members of the no. 1 multiplet of OII all of which, except for one weak member, are included between 4639 A. and 4676 A. It seems very likely, therefore, that this OII multiplet can account for the emission band. Another OII multiplet, no. 10, at wave-lengths 4069 A. to 4092 A., seems also to be indicated on the later plates by a broad, faint emission to the violet of Hδ.

There remains to be described also an absorption feature in the same spectral region as the foregoing strong emission features, namely the appearance, in considerable strength, of multiplet no. 5 of NII at 4601–4643 A. This multiplet was first seen on our plate of August 30 and increased in strength until September 10; on September 16 the intensity seemed to have fallen off a little. There was probably emission to the redward side of each absorption line, but the fairly regular spacing of the lines made it difficult to be sure. On the plates of September 10 and 16 it was possible to make settings with confidence on four of the six members of the multiplet with the results, for radial velocity, shown in

TABLE IV

RADIAL VELOCITIES (KM./SEC.) FROM NII MULTIPLET NO. 5

Wave-length	Sept. 10	Sept. 16
4607.17	−584	−550
4613.88	−565	−510
4621.41	−551	−544
4630.55	−596	−528

Table IV. These give means of − 574 km./sec. for September 10 and − 533 km./sec. for September 16. As regards the two members of this multiplet which are missing from Table IV, the line 4601.49 A. was not seen at all, and the line 4643.11 A. was seen but gave velocities disagreeing with those from the other lines (− 682 and − 664 km./sec.). The reason for the absence of the 4601 line seems to be that its position corresponded precisely with that of the emission core of FeII 4583.84 which could be clearly seen on a strong plate of September 3. The reason for the discordant velocities from the 4643 line may lie in the blending with CrII 4634.11 of the principal spectrum or possibly with OII lines near that wave-length.

Since NII is characteristic of the Orion stage of a nova spectrum, a search was made for other absorption lines of the Orion spectrum which might have been expected to appear at the same time. Four other NII lines, 4667.20 A., 4779.71 A., 4803.27 A. and 4774.22 A. were identified with fair certainty, but no absorption lines of OII or HeI were identified. Andrillat and Fehrenbach[5] have reported the appearnace of HeI 5875 and 6678 from August 30 on. On our plates HeI 4471 might have been expected to appear on later dates were it not that its position with a displacement of — 550 km./sec. would coincide with that of the line TiII 4468.49 of the principal spectrum. However, on and after September 3 there was a strengthening of this 4468 line relative to the nearby line, TiII 4443.80, and this is probably due to a contribution by the helium line.

Wellmann[4] has studied the photometric data for Nova Scuti and has estimated that it declined .3 magnitudes from its maximum in 40 days. The mean velocity of 373 km./sec. derived from the lines of the principal absorption spectrum is rather low for this rate of decline, judging from the relation which McLaughlin[7] has established for other novae; in fact the fit of this nova on his plot is worse than for any other.

Two attempts have been made to estimate the distance of the nova from the spectrograms: (a) from a measure of the intensity of the interstellar K line, which gave 4600 parsecs for the distance and — 5.6 for the absolute magnitude at maximum, uncorrected for space absorption; and (b) from the radial velocity of the *H* and *K* interstellar lines (mean value + 48 km./sec. for ten plates), using the principle of galactic rotation,[8] which gave 8800 parsecs for the distance and — 7.0 for the absolute magnitude uncorrected for space absorption. When correction is made for absorption using the method described by McLaughlin[9] the absolute magnitudes from the two methods become — 8.5 and — 10.2. One hesitates to accept such high luminosities; probably they reflect the inappropriateness of the methods for large distances.

The writer gratefully acknowledges helpful suggestions regarding line identifications from Dr. D. B. McLaughlin.

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VARIABLE STAR NOTES

American Association of Variable Star Observers

By MARGARET W. MAYALL, *Recorder*

SS *Cygni*, 213843. Variable star observers throughout the northern hemisphere have once again upheld their reputations for constant observations of SS Cygni. During 1952, seven maxima were observed, and the observations were continuous enough so that we can be sure that not one maximum was missed. The observers made 1,427 observations on 299 nights during the year; these include 250 observations made by eight members of the Scandinavian Astronomisk Selskab, and sent to us by Dr. Axel V. Nielsen.

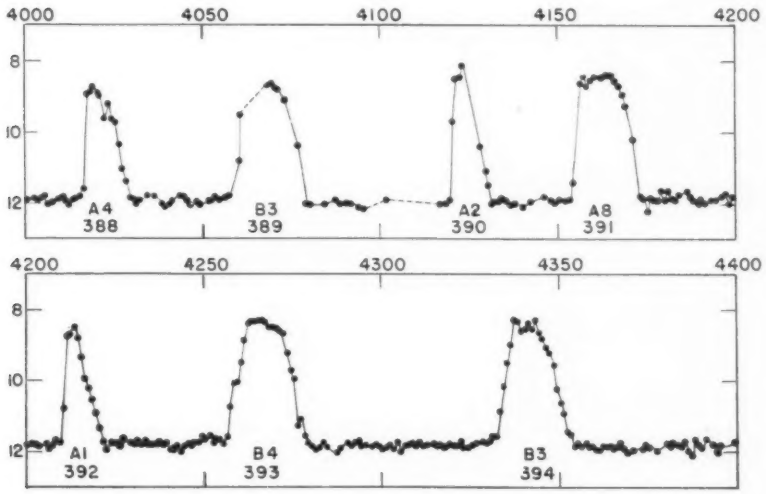

FIG. 1—SS Cygni, 213843. Daily means in 1952.

The light curve in figure 1 is plotted from daily means of all the observations received during the year. It is a continuation of the curve printed in these notes in July 1952 (*R.A.S.C. Jour.*, vol. 46, no. 4, p. 152). The 1952 maxima are numbered 388 to 394, counting from the first maximum after the discovery of SS Cygni in 1896.

Table I lists the Julian Days and magnitudes of the observed maxima; the type of

TABLE I

OBSERVED MAXIMA OF SS CYGNI

No. Max.	Type	10.0 I J.D.243 +	Diff.	Max. J.D.243 +	Diff.	10.0 D J.D.243 +	Diff.	Max. Mag.
388	A4	2434017	36	2434019	37	2434026	38	8.7
389	B3	4061	44	4066	47	4076	50	8.5
390	A2	4120	59	4123	57	4128	52	8.1
391	A8	4156	36	4162	39	4171	43	8.4
392	A1	4211	55	4213	51	4217	46	8.5
393	B4	4259	48	4265	52	4275	58	8.3
394	B3	4335	76	4340	75	4349	74	8.3

each maximum; and the Julian Days for magnitudes 10.0 on the increasing and decreasing branches of the curves. The mean interval between maxima in 1952 is 51.1 days, which is near the mean value of 52.0 days for the intervals between the 394 maxima since discovery. Each maximum is classified according to the shape of the curve, as described in *Harvard Annals*, vol. 90, no. 3, 1934, by Leon Campbell. Type A has a much steeper rise to maximum than type B; type C is even less steep; and type D, which occurs rather rarely, has a very slow rise. The numbers following the type letters increase as the width of maximum increases.

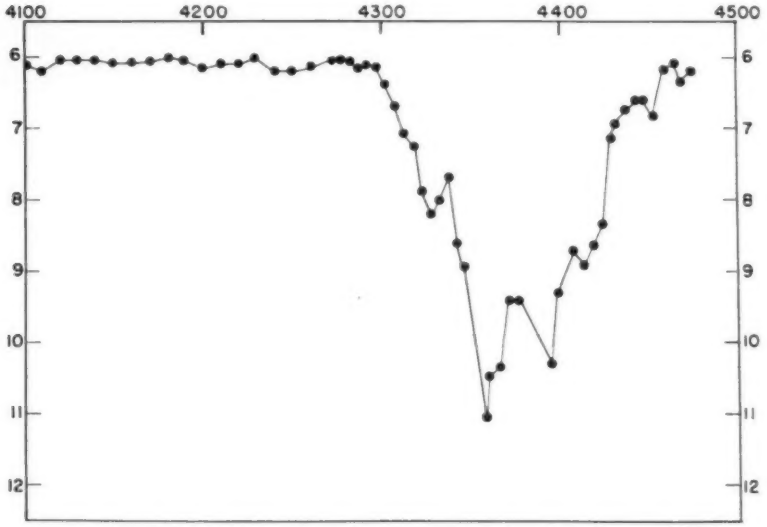

FIG. 2—R Coronae Borealis, 154428. Minimum of 1952–1953.

R Coronae Borealis, 154428. R Coronae Borealis has returned to normal brightness. The light curve in figure 2 is plotted from the five-day means of A.A.V.S.O. observations. Many of the irregularities are due to the small number of observations made while the variable was near conjunction with the sun. Fortunately, our observers made special efforts to follow it in the early evening and late morning hours, and we have a fairly good record of the variable's activities.

News Release. The following statement was given to the press early in April:

"Mrs. Margaret W. Mayall of Harvard College Observatory announced yesterday that the American Association of Variable Star Observers is about to embark upon a campaign for funds to support its important scientific work. With hearty endorsements from leading astronomers in many countries, it plans a broader programme for observing variable stars, the sun, lunar occultations, and aurorae, with a renewed emphasis on accuracy and the use of modern electronic equipment. The members of the A.A.V.S.O. from forty states and thirty foreign countries have made nearly 1,500,000 observations of the brightness of variable stars over the past forty years. To-day this organization is the authority on the ups and downs of the brightness of long period and irregular variable stars. A book to contain some 400 light curves of variable stars–the work of the A.A.V.S.O.–is due to come out this year."

We are starting this drive with the hope of making the future of the A.A.V.S.O. more secure. We should have a large enough endowment to make us self-supporting, so that we do not have to ask for special gifts or help from any institution to meet our operating and publication expenses.

Nova Search Programme. During the months of February and March 1953, reports were received from the following 7 observers. Listed for each observer is the month of the observation, the areas observed (in italics), the number of nights the region was checked, and finally, the limiting magnitude.

DARSENIUS, GUNNAR, Feb.– *Dome*: 5, 2; *16, 17*: 8, 6; Mar.–*Dome*: 5, 2; *16, 17*: 5, 6.

*DIEDRICH, DELORNE, Feb.–*40*: 2, 3; Mar.–*Dome*: 2, 2; *94*: 5, 6; *94*: 2, 5; *94*: 1, 3.

*DIEDRICH, GEORGE, Feb.–*56*: 2, 4; *78*: 1, 5; Mar.–*Dome*: 4, 2; *56*: 6, 6; *56*: 2, 4.

*MAHER, JAMES, Feb.–*Dome*: 2, 2; *50*: 2, 4; Mar.–*Dome*: 3, 2; *50*: 3, 4.

*RICK, LOUIS, Feb.–*Dome*: 2, 2; *Dome*: 3, 1; *63*: 1, 5; *18, 65*: 2, 5; *18, 65*: 2, 4; Mar.–*Dome*: 2, 2; *Dome*: 3, 1; *63*: 1, 5; *18, 65*: 4, 5; *65*: 2, 4.

ROSEBRUGH, D. W., Feb.–*Dome*: 6, 3; *Dome*: 2, 2; *1*: 4, 4; *34*: 5, 4; Mar.–*Dome*: 10, 3; *Dome*: 2, 2; *1, 34*: 2, 4.

SMITH, F. W., Feb.–3, *4*: 10, 6; Mar.–3, *4*: 8, 6.

*Black River Astronomical Society

Observations received during February and March 1953: In February 4,302 observations were contributed by 47 observers, and in March 3,477 were received from 58 observers, making a total of 7,779 for the two months.

Observer	February No. Var.	February No. Ests.	March No. Var.	March No. Ests.	Observer	February No. Var.	February No. Ests.	March No. Var.	March No. Ests.
Adams, Robert M.	65	141	71	133	Howell, Shapleigh	6	10	4	4
Anderer, Joseph A.	6	6	31	47	Isaak, George	15	33	5	7
Anderson, Curtis E.	62	100	88	179	Johnsson, Robert	—	—	4	4
Archer, S.	10	201	6	11	Kanda, Sigeru	—	—	12	159
Bartha, Lajos	—	—	6	26	Kelley, Leo A.	8	10	21	24
Beidler, Herbert B.	4	5	8	13	Kelly, Frank J.	13	14	10	10
Botham, John H.	19	30	15	15	de Kock, Reginald	102	464	111	464
Boutell, Hugh G.	6	13	6	22	Mebius, William	3	5	3	4
Buckstaff, Ralph N.	7	7	15	22	Melville, E. C.	5	7	10	12
Chandra, Radha G.	43	50	69	96	Miller, William	13	18	25	30
Charles, Donald F.	25	35	32	43	Milone, Luis A.	23	31	—	—
Chester, Bryant	9	18	10	18	Montague, Allen C.	1	1	26	30
Chiabotta, Ronald	—	—	2	2	Neff, John	—	—	7	9
Cobb, Hensley	—	—	6	8	Oravec, Edward G.	61	164	94	321
Cragg, Thomas A.	156	160	58	59	O'Sullivan, William	12	42	18	57
Darsenius, Gunnar	122	257	42	108	Overbeek, M. D.	51	101	65	99
Diedrich, DeLorne	1	1	4	12	Parker, P. O.	29	31	—	—
Diedrich, George	1	1	8	23	Pearcy, Robert E.	7	7	9	9
Elias, Demetrius P.	87	1096	—	—	Peltier, Leslie C.	39	136	21	52
Escalante, Francisco	—	—	43	72	Pèsa, Ladislaus	—	—	4	6
Fernald, Cyrus F.	96	193	65	76	Pohl, Eckhard	—	—	17	88
Ficonetti, Rene	19	31	—	—	Renner, Carl J.	59	59	161	162
Fink, Richard R.	—	—	1	1	Rosebrugh, David W.	19	103	18	139
Ford, Clinton B.	106	109	84	85	Ruiz, John J.	—	—	1	102
Galbraith, William	39	133	45	84	Sinka, Jozef	—	—	3	5
Gaustad, John	1	1	4	4	Szàntai, Lèrànt	—	—	3	6
Greenley, Robert	15	16	50	52	Taboada, Domingo	117	200	79	129
Haberstrok, Robert A.	—	—	7	9	Tarbell, E. D.	10	14	15	20
Hales, LaVaughn	—	—	2	7	Venter, S. C.	38	57	55	74
Hartmann, Ferdinand	127	128	126	132	Webb, Harold B.	7	7	—	—
Holloway, Leith	—	—	6	7	Wyckoff, Jerome	17	20	25	46
Houston, Walter	—	—	11	39	Yamada, Tatsuo	18	36	—	—

Harvard College Observatory
Cambridge 38, Massachusetts
April 15, 1953

NOTES FROM OBSERVATORIES

Dominion Astrophysical Observatory, Victoria, B. C.

Staff. As reported in last month's Journal, two members of the staff have been since the beginning of this year at the University of Toronto, Dr. Andrew McKellar serving as visiting Professor of Astronomy and Physics, and Dr. Jean K. McDonald studying the application of the Ferranti electronic computer to the problem of stellar atmospheres.

Mr. Graham J. Odgers is on leave of absence on duty as a reserve officer with the Royal Canadian Navy to attend the naval review in connection with the coronation.

Mr. A. R. Salonen joined the Observatory staff last July. The workshop is fortunate in securing Mr. Salonen's services to assist in handling the increased demand for specialized equipment.

Instruments. The new stellar spectrograph has been in operation for some months. It is performing well and has improved the observing facilities in the ease of changing from one form to another. A number of labour-saving devices, made possible by the new design, are under construction and new cameras to replace the cumbersome originals are on the drawing board. The optical parts of a more powerful Littrow spectrograph have been received as well as the optics for a quartz prism-spectrograph. Several new and quite superior gratings have been added to the equipment in the last few months.

Dr. Su-shu Huang of the Astronomy Department at Berkeley spent a few days at the Observatory in December. Dr. Huang discussed with the staff some problems of the interpretation of absorption lines relative to the structure of stellar atmospheres and inspected some high-dispersion spectra of the Observatory collection.

Office Building. The long-awaited addition to the office building is virtually completed. In addition to increased space for an enlarged staff the new building features a fine seismographic section, laboratory and workshop, and a substantial library addition as well as adequate space for the photographic and drafting section. It is expected that the new building will be ready for occupancy at the end of spring.

REVIEW OF PUBLICATIONS

The Aurorae, by L. Harang. Text, 157 pages, 6 × 9½ inches, 152 figures, 5 pages of bibliography, 2 of index. London: Chapman and Hall. Toronto: British Book Service, 1068 Broadview Avenue. $5.00, 1951.

This is the first volume of the International Astrophysics Series of which the General Editors are M. A. Ellison of the Royal Observatory at Edinburgh and A. C. B. Lovell of the University of Manchester. Its author is L. Harang who has been very active in observing the aurora in Southern Norway and is now chief scientist in the Norwegian Defence Research Establishment.

There are eight chapters in the book: I. The forms and appearance of the aurorae. The parallactic method for measuring heights. II. The position in space of the aurora. III. The spectrum of the aurorae. IV. Other light effects from the auroral region. V. The earth-magnetic storms and the aurorae. VI. The corpuscular theory of the aurorae. VII. The upper atmosphere and the aurorae. VIII. The ionosphere, the aurorae and the earth-magnetic perturbations.

From the above list it will be seen that every important subject relating to the aurorae is treated in this book; and a serious effort is made to present clear-cut quantitative results in each case. The determination of the heights of the aurora by C. Störmer about 1913 was perhaps the most important work done on the aurorae and it is explained in great detail in this book. Other chapters are equally comprehensive. On page 60 there is an interesting reference to aurorae at low heights and to sounds accompanying the aurorae.

C. A. C.

The Atmospheres of the Earth and Planets, edited by Gerard P. Kuiper. Revised edition. Pages viii plus 434; 6¾ × 9½ in. Chicago, The University of Chicago Press, 1952. Price $8.50.

This is a revised edition of a very valuable compilation first made in 1948, of articles on various aspects of the atmospheres of the earth and planets written by well-known authorities. In the new edition there have been incorporated extensive revisions in chapters entitled: rocket research programmes, spectra of the night sky and the aurora, rare gases

and the formation of the earth's atmosphere, infra-red spectroscopy of the solar system, laboratory absorption spectra, and planetary atmospheres and their origin. The last-mentioned chapter is by Kuiper himself and the revision and expansion (from 40 pages to 100 pages) of this chapter is the most important change in the new edition. In this chapter Kuiper gives many new data bearing on the origin and development of the atmospheres and shows how these may be tied together to support his recent views on the origin of the solar system. Particular attention is also paid to the recent important contribution of Urey to the subject of the development of the planets and of Herzberg to the subject of planetary atmospheres.

J. F. H.

Radio Astronomy, by Bernard Lovell and J. A. Clegg (Frontiers of Science Series). Pages 238, 5¼ × 7¼ in. London, Chapman and Hall, 1952. Price $3.50.

This book is the first one generally available on that most fascinating of new branches of astrophysics—radio astronomy. Both the senior author, who holds the newly-created chair of Professor of Radio Astronomy in the University of Manchester, and the junior author, are in a position to write authoritatively on the topic, because of their active research at the Jodrell Bank Experimental Station, one of the world's foremost radio astronomy research centres.

It is obviously impossible to please all potential readers of a book, and the authors have directed this work primarily toward physicists, radio engineers, and astronomers, and indeed all with some mathematical and physical background, who want to have access to quantitative and authoritative data concerning radio astronomy.

The first two chapters contain an astronomical orientation which should be useful to the radio engineer. Directed more toward the astronomer are chapters on the physical basis of radio methods of investigation. The bulk of the rest of the book treats the three branches of radio astronomy: radar observations of meteors, solar radio radiation and radio radiation from the galaxy and radio stars. In the case of each topic, the authors present orientating material from other branches of astronomy, an account of the more important observations, and considerable material on the theoretical interpretation of the observations. Final chapters discuss radio observations of the aurora and of the moon, and possible future radio observations.

The authors are understandably at their weakest in the purely astronomical sections of the book; however, only one or two actual errors were detected by this reviewer. On page 1, Bayer's name is misspelled, and a hyphen is erroneously used here and elsewhere in the book in star-names to connect the Greek letter to the constellation name. Thus, α Andromedae becomes α-Andromedae. In the Appendix, there are some errors in the number of satellites ascribed to the outer planets. Aside from such minor matters, the radio engineer who may find hard going in the astronomical chapters can always have recourse to standard astronomical references thoughtfully provided by the authors. This reviewer feels that the book leaves quite the wrong impression concerning the present knowledge of the solar parallax. But this does not mean that a determination of its value by radio methods would be useless—far from it!

A number of plates, as well as half-tones and diagrams are included. On the whole the reproduction, style, and proof-reading are good.

It is to be hoped that the authors are already at work on a revision of their book, in order to keep pace with this fast growing field.

R. E. W.

Der Sternenhimmel, 1953. Pages 106; 5¾ × 8¼ inches. Published by H. R. Sauerlander and Co., Aarau, Switzerland. (Obtainable through Mr. Albert J. Phiebig, 545 Fifth Ave., New York 17, N.Y.)

This year-book is published under the auspices of the Swiss Astronomical Society in a form similar to that of our own OBSERVER'S HANDBOOK. It demonstrates once again the active character of the Swiss and their astronomical organization.

W. R. HOSSACK

Astrophysics, a Topical Symposium, edited by J. A. Hynek. Pages 703 + xii; 9¼ × 6 inches; illustrated. Ntw York, McGraw-Hill, 1951.

This book, which commemorates the fiftieth anniversary of the Yerkes Observatory, is described by its editor as a review of progress in astrophysics during the past half-century. Fourteen contributors, mostly astrophysicists who have been closely associated with the Yerkes Observatory, have contributed chapters on various topics such as Comets, Eclipsing Binaries, Interstellar Matter, etc. All these topics are grouped into four parts entitled *Spectrographic Astrophysics, Physics of the Solar System, Physics of Binary and Variable Stars* and *Physics of Cosmic*

Matter. Each contributor was asked to review his topic from the point of view of its growth over the past half-century and its present challenging problems. This, as the editor says, precluded a systematic coverage of astrophysics such as one would expect to find in a text-book; yet the book has much more unity than a mere collection of review papers.

To say that *Astrophysics* is not a text-book is not to say that it is a popular account of the subject. A few of the chapters could be read with interest and pleasure by a person with some general knowledge of astronomy, but most of them require a background of advanced physics and call for careful study rather than casual reading. It is a book well suited for a graduate student in physics or astronomy who requires either an overall picture of modern astrophysics or a starting point for a detailed study of a particular topic. Most of the chapters have good lists of references which are invaluable in a work of this kind.

J. F. H.

NOTES AND QUERIES

On the Origin of Chubb Crater

Dr. F. C. Leonard recently (see this Journal, vol. 46, p. 252) expressed his objections to calling the Mexican Crater Elegante meteoritic, pronouncing it to be of definite volcanic origin. Now the University of California *Clip Sheet* quotes him as also questioning the origin of Chubb Crater in Quebec. According to Drs. La Paz and Healy of the University of New Mexico, the walls of the crater are different from those of known meteorite craters. Leonard suggests that it, too, may be of volcanic origin. This theory had already been postulated by its discoverer, Chubb, and dispelled by the geologist on the spot, Meen. However, under unusual conditions, differences of opinion are permissible.

In regard to the Carolina Bays, meteoritic origin has often been questioned, and few people still accept the meteoritic interpretation. Leonard favors the theory of Douglas Johnson attributing such formations to the combined action of natural artesian wells, solution, lakes and winds. We find the recent glacial theory of von Drabbe stimulating.

In a monograph, "Aerial Photograph and Photo Interpretation", distributed at the September meetings of the International Society of Photogrammetry, Colonel C. A. J. von Freitag Drabbe of the Netherlands Topographic Service, reported on the discovery through aerial photographs, of formations in the Netherlands similar to the Carolina Bays. He believes both groups of oval depressions are glacial phenomena produced by the melting of glacial ice. Some of the ovals may have been formed when already buried glacial ice (*ice fossils*) melted and the overlying layers of sediment collapsed. Bringing together many geological factors (particularly on the nature of the rocks and boulders near the Netherlands craters, which are not native to the vicinity but correspond to those of the mountains of Finland and Scandinavia) von Drabbe presents a very convincing case for his theory.

In the case of the Chubb Crater, Meen had also already considered and rejected a glacial theory for its origin. Perhaps, however, a modification of von Drabbe's theory should be considered. The region is not one of profuse past volcanic activity (as in the case of Crater Elegante), whereas fossil glacial ice is likely to abound there.

Dorrit Hoffleit

Northern Lights Created in the Laboratory

The appearance of a display of northern lights or aurora borealis leads one to wonder how they are formed. In recent years Dr. A. B. Meinel of Yerkes Observatory has obtained spectra of the aurora and formulated a theory of their origin. Further confirmation of his theory has come from work in the laboratory and is reported in the November 1952 issue of *Physics Today*. Dr. Meinel and C. Y. Fan used the kevatron at the University of Chicago's Institute for Nuclear Studies, and bombarded air at low pressures with alpha particles and protons. The spectrum of the light produced in this way was strikingly similar to that of the aurora. It is deduced that the light of the aurora is produced when air molecules in the upper atmosphere are struck by heavy particles from outer space; part of the auroral effect may be produced when electrons associated with atmospheric atoms are captured by protons.

R. J. N.

Jupiter and the Sun

Much work has been done in attempting to correlate phenomena observed on the sun with terrestrial phenomena. One such correlation, found by Dr. Clarence E. Palmer of the University of California, is between solar flares and terrestrial upper-level cyclones and tropical rainstorms. This suggested to a colleague, Dr. Yale Mintz, that a similar effect might be found on Jupiter. Dr. Mintz, working at Lowell Observatory, studied the spots that appear on Jupiter. He concluded that the spots are really storms in the upper levels of Jupiter's atmosphere and that they are started by solar radiation in much the same way as the cyclones are formed in the earth's upper atmosphere in the tropics. The spots on Jupiter seem to form a few days after an intense solar disturbance, and are more frequent during sun-spot maximum.

R. J. N.

New Address: 15 Ross Street, Toronto 2B

The business office and library of the Royal Astronomical Society of Canada has been moved from 3 Willcocks Street to 15 Ross Street, Toronto 2B. Ross Street is a short street running south from College Street, opposite the Toronto Public Reference Library.

Dr. William R. Hossack, the Society's Librarian, has been in charge of the moving. Considerable reorganization of the library material has been effected, and an announcement regarding the library hours will be forthcoming shortly.

All correspondents should take notice of the change of address.

E. J. A. Kennedy

MEETINGS OF THE SOCIETY

AT MONTREAL

April 17, 1952.—The meeting was held at Macdonald Physics Building, McGill University, with the President, Miss I. K. Williamson, in the chair.

Mr. Russell Yeoman was admitted to membership in the Society on motion of F. DeKinder, seconded by R. O. Stevenson.

Attention was drawn to the exhibition at l'Art Français of a series of paintings by Rene Richard of Northern Ungava and the Chubb Crater region.

The speaker of the evening, Henry F. Hall, Dean of Sir George Williams College and Secretary of the Montreal Centre, was introduced by the chairman. The Dean had chosen as his subject "The Astronomy of Kepler." He reviewed the four great leaders of the astronomical revolution—Copernicus, Galileo and Tycho Brahe—by means of whose theories and observations Kepler was enabled to further the great advances made in knowledge. In the course of the lecture slides were shown to explain astronomical theories current in the period of the lives of these great leaders of thought. The works of Kepler in which his three laws are explained were briefly commented upon, the laws stated and some illustrations given to show that, with remarkably little modification, an instrument of great power was placed in the hands of Kepler's successors down to our own time. In extolling the work of this great thinker, the speaker closed his address with the quotation "The glory of Kepler is in the heavens."

After the President had tendered to Dean Hall the thanks of the Centre, the meeting adjourned, 55 members and visitors having been present.

May 8, 1952.—The meeting was held at Macdonald Physics Building, McGill University, with the President, Miss I. K. Williamson, in the chair.

On motion of F. DeKinder, seconded by Paul S. Scott, Mrs. P. G. Kirkpatrick was elected a member of the Society.

The programme for the evening, "An Astronomical Medley", consisted of contributions by a number of the members and was an interesting departure from the usual form of meeting. It included the following:

Reading from Huxley's "The Captive Shrew" by F. DeKinder.

"How to calculate the age of the moon on any given date," method demonstrated by Miss Williamson.

Reading from Service's "The Ballad of the Northern Lights" by E. E. Bridgen.

Brahmin legend of the end of the universe, with demonstration of the 64 disks by Brian Cockhill.

Reading from Noyes' "Watchers of the Sky" by Dean Hall,

and a number of impromptu items from the audience.

As customary at the closing meeting of the season, a social period followed during which refreshments were served. 80 members and visitors were present.

E. E. Bridgen, *Recorder.*

REPORT OF THE DIRECTOR OF OBSERVATIONS, MONTREAL CENTRE, FOR THE YEAR 1951–1952.

The *Occultation Section* scheduled 77 occultations of which 10 were successfully timed. Four members have participated in this work, sometimes at great inconvenience.

Telescopic Observations of Sun-spots have been carried on regularly from two stations. At one station 206 observations were made, reporting 544 groups and 3742 individual spots. At the other station 124 observations were made, 539 groups and 4719 spots seen.

Naked Eye Sun-spot observations have been carried on by five members. The number of spots visible to the naked eye has greatly diminished from last year. 58 reports of spots observed have been received.

Under *Planetary Observations*, we continued the evaluations of the brightness of Uranus. Four reports, containing 33 observations were received and forwarded to the proper departments. Six observations of the planet Mars during its latest opposition were made and duly reported.

The *Lunar Section* participated in the programme of observations of the Crater Haze to verify any possible changes that may have been detected there. Seven drawings were forwarded to the Association of Planetary and Lunar Observers.

The *Aurorae Section* received 160 reports from 22 members covering the observation of 86 auroral displays.

Ten members participated in the observation of the Perseid meteor shower on August 13–14 during which 78 meteors were recorded.

The *Sporadic Meteor Division* reported 25 observations made by eight members. No spectacular meteors or fireballs were seen this year.

75 reports, all of them negative, were received by the *Nova Search and Comet Division*. One observer though suspected a change in brightness of a small star in the constellation Lynx and this observation was forwarded speedily to Harvard College Observatory, where the star was kept under observation for some time, so far with inconclusive results.

The *Group of Telescope Makers* held 35 meetings with an average attendance of seven members and seven telescopes were completed. The observation Committee again wants to express its gratitude to Mr. and Mrs. Eugene Charters who so generously continue to provide shelter and a warm welcome to this section.

The *Migratory Bird Section* participated an extensive programme of watching bird migration at full moon periods this fall. Observations were made from four different stations and twelve members participated. A total of 164 birds were clocked during these observations.

The *Asteroid Club* and the *Messier Club* are continuing their activities. Special mention must be made of the work of our young member Earl Milton who early this year moved to Edmonton. There he has succeeded in interesting a number of Edmontonians in auroral, planetary and meteor observations.

The Saturday evening observation meetings have been held every Saturday of the year. A repeat programme of the study of all the visible constellations has been carried out.

Our different starnights have been very successful from the point of view of attendance. However the weather did not co-operate and the meetings served to keep alive the interest of the public in our activities.

FRANK J. DEKINDER, *Director of Observations.*

REPORT OF LIBRARIAN, MONTREAL CENTRE, FOR THE YEAR 1951–1952.

Included in additions to the library during the year were several of the latest publications on astronomy and related subjects, and also others of historical interest, the latter dealing with the life and times of Tycho Brahe, Kepler, and Copernicus. A large backlog of binding and repairs was also considerably reduced.

Our collection of Old Astronomical Books of one hundred years of age or more continues to grow. An item of particular interest is a Star Atlas published in 1835 in which the planet Uranus is called Herschel. All additions, binding and repairs were made possible by gifts of members and friends and generous support of the Centre's council.

Members invited to address various groups on their favourite subject made extensive use of the Centre's projector, slides and screen.

BOOKS PURCHASED BY THE CENTRE

A Concise History of Astronomy
Relativity and its Astronomical Implications
Eclipses of the Sun
Photographs of the Moon (Unbound)
Time and its Mysteries (Series 1–2 & 3)
The Life and Times of Tycho Brahe
The Expanding Universe
The Life and Letters of Johannes Kepler

PRESENTED TO THE LIBRARY

Frontiers in Space
The Aurorae
The Stars
A Key to the Stars
Sunspots in Action
Other Worlds than Ours
British Nautical Almanac (1953)
Star Stories
The Heavens are Telling
Bibliography of Extraterrestrial Noise (Radio Astronomy)
Astrophotography and The Great Telescopes of the Future
The Nature of the Physical World
The Story of The Solar System
Present-Day Astronomy
The Mysterious Universe
Star Atlas, Published 1935

BINDING AND REPAIRS

Splendours of The Sky
The Universe Around Us
R.A.S.C. Journal 1951
Bibliography of Extraterrestrial Noise
Mars and its Canals
Frontiers in Space
Astrophotography and The Great Telescopes of the Future

Circulation count of books, 227; periodicals, 180.

CHARLES M. GOOD, *Librarian.*

AT OTTAWA

January 17, 1952.—National Museum Lecture Hall.

The president welcomed a new member, Mr. C. V. F. Weir, to the Society. Announcement was made of coming lectures by Dr. Gamow and Dr. Meen.

The speaker of the evening, Warren D. Forrester, a Hamilton man, graduated from Toronto in Mathematics and Physics in 1947, and has since worked for the Geodetic Survey of Canada all over Canada's north by scow, snowshoe, dog-team and plane.

His subject was "Shooting Stars out of Season in Canada's Northland". He explained that his 'shooting' was done with a transit or theodolite—and that he was not responsible for falling stars or exploding stars!

Until a couple of years ago only part of the eastern end of the Alberta-N.W. Territories boundary had been surveyed. Mr. Forrester's talk was to "pin down" about ten points at twenty-five-mile intervals, leaving markers. Later survey would create a monument of cut line to mark the boundary. These points had to be within twenty chains of the sixtieth parallel, and their position known to within ten feet. Preliminary determinations were made with a theodolite, the final positions were found using a broken-type transit.

Since the country is largely muskeg, the work had to be done in winter. As there were no lakes suitable for landing planes, tractor trains were used to carry the party and its equipment. Temperatures down to sixty degrees below zero were experienced. Numerous coloured slides illustrated the difficulty of the terrain and the rigours of observing. Mr. Forrester spoke of the pleasure of returning to Ottawa at sixty miles an hour after so many miles in a caboose at two miles an hour.

The interest of the audience was evident in the numerous questions that followed the lecture; these ranged from "why must a boundary be determined between Alberta and the North-West Territories anyway?", to "what keeps the chronograph ink from freezing?"

Mr. C. H. Ney thanked the speaker for his witty and entertaining account.

February 29, 1952.—A large audience assembled in the National Museum Lecture Hall to hear Dr. J. F. Heard's lecture on "Exploding Stars". He described three common greetings calculated to irritate astronomers: 'So you're an astrologer?'; 'Have you seen any men on Mars?'; 'Found any new stars lately?'. His talk dealt with these new stars, or Guest stars, as the Chinese called them.

Novae are not uncommon, being observed at the rate of several a year. These increase a hundred-thousand fold in brightness, from the glimmer of a candle to the glare of a search-light. This was illustrated by slides of the light curves of several novae. They are indeed exploding stars, matter being driven off at velocities of hundreds of miles a second—to form an expanding shell. Studies with the spectrograph give a great deal of information as to what goes on in these cataclysms.

Dr. Heard discussed the typical case-history of a nova, which begins as a dwarf star about one-tenth the sun's diameter, one-third to one-fifth as bright, but hotter, and ends up at a high temperature of ten or twenty thousand degrees Centigrade, perhaps surrounded by nebulosity like that of the Crab Nebula. There is evidence that some stars are addicted to nova-ism and go on periodic sprees.

After touching on the rarer super-novae, the speaker outlined the views of modern cosmologists on the place of these exploding stars in the universe. Of particular

interest is the suggestion that planetary systems may be a by-product of the explosion.

Dr. Heard answered a number of questions, assuring us that the sun is a sober and well-behaved star. The observed accelerations of shells are probably due to radiation pressure. A unified theory of stellar evolution is nearly within our grasp.

Dr. Millman thanked the speaker warmly on behalf of the audience for his simple and concise exposition of the present state of knowledge in this field.

March 15, 1952.—The meeting was held in the National Museum Lecture Hall.

First vice-president W. S. McClenahan introduced the speaker, Dr. John Hodgson, head of the seismology division of the Dominion Observatory. Dr. Hodgson spoke on "Seismology and the Internal Structure of the Earth". Disturbances within the earth give rise to waves of various types and velocities. A seismograph records the time of arrival and the intensity of these waves, and by analysis of the travel-time curve, the seismologist can investigate the nature and extent of the materials within the earth. Some of these disturbances originate at depths as great as 750 kilometres. Current work on these lines pictures the earth's crust as a layer of granite and basalt 36 kilometres thick, with a sharply-defined base.

Local studies may be made by setting off an explosion on the surface, and timing the arrival of the resulting waves at nearby geophones. In this way the geophysicist can find the thickness of the overburden, and other information of value to the prospector or miner.

After a question and answer period, Dr. T. L. Tanton of the Geological Survey, thanked the speaker.

April 17, 1952.—The meeting was held in the National Museum Lecture Hall.

The president introduced the speaker, W. M. Cameron, as a senior technical officer of the National Research Council, who became interested in amateur telescope-making as a hobby. Mr. Cameron, under the title "Making and Using a Small Telescope", took the audience through the steps in making a reflecting telescope—rough grinding, test for centre of curvature, fine-grinding, pitch tool-making, rouge polishing, Foucault test—down to collimation of the optical system in the telescope mounting. He discussed some of the factors to be considered in using the telescope—seeing, diffraction effects, and magnification. He has found the sun and moon good subjects for an amateur's telescope; Mercury always poor in the city, as was Mars, except near opposition; Venus, Jupiter, and Saturn good; double stars, clusters and variables all interesting; most nebulae rather poor with a small instrument. He concluded by noting the books and periodicals he has found useful in making and using a small telescope.

As a companion piece to the lecture, a film "Making a Newtonian Telescope" by the Amateur Telescope Makers of the Franklin Institute was shown, illustrating some of Mr. Cameron's points.

Mr. A. E. Covington, who confessed to being an "ATM-Nut" of twenty years' standing, thanked the speaker.

October 23, 1952—The meeting was held in the National Museum Lecture Hall.

The fall series of lectures opened with "Solar and Lunar Influences on the Earth's Magnetism" by Dr. Julius Bartels of Göttingen. Introducing the speaker, Dr. Davies said he had known Dr. Bartels for twenty years as an excellent lecturer, and a warm and friendly personality, as well as author of *the* treatise on geomagnetism.

As all roads lead to Rome, Dr. Bartels declared, all compass needles lead to Canada, and that was one of the reasons he had been spending some time with the Dominion Observatory's Magnetic Division.

The earth is thought to be five billion years old, but its magnetic field is still not stationary. Dr. Bartels wished to speak on the rapid fluctuations in the earth's magnetism rather than the permanent field or its secular changes. These rapid changes are related to the effects of the sun and the moon on the earth. Electrical currents high in the earth's atmosphere produce a magnetic field, and the magnetic changes under consideration are due to changes in these atmospheric currents. The sun's ultra-violet light ionizes air particles, and makes the ionosphere as conducting, roughly, as sea water. And although the light and heat supplied by the sun are fairly constant, the other parts of its output absorbed by the upper atmosphere are highly variable. The variations are connected with sun-spots, faculae, flares, and so on. Because these variations greatly affect wireless transmission, the subject is of great practical importance, and has led to a happy symbiosis of the magnetic observatory with the ionospheric observatory.

As well as the ultra-violet radiation, clouds of solar gas come into the earth's atmosphere at speeds of about one thousand miles a second, and are partly deflected by the earth's field so as to arrive mainly at the poles. This works something like the familiar neon tube to produce the aurora. All auroras are accompanied by magnetic disturbances, and a magnetician can detect an aurora two thousand miles away, and he is not hindered by daylight or clouds. His sensitive equipment responds strongly to all sorts of electromagnetic disturbances—the Potsdam scientists found that their instruments recorded only too faithfully the schedule of the nearby electric railway—so he seeks more and more remote locations for his observatories, moving from Toronto to Agincourt; or from Ottawa to Meanook, to Baker Lake, to Resolute Bay.

Dr. Bartels spoke of some famous magnetic storms. The solar outburst in 1859 was so great that the aurora was seen in Cuba, and it was on this occasion that Carrington, studying sun-spots at Greenwich, found allied magnetic disturbances at Kew, and exclaimed "We have caught the sun in the act!". The storm of 1940 induced potentials of one thousand volts in telephone lines in Norway. A 1947 storm sent a shower of cosmic ray particles from the sun to the earth in twenty minutes, while a 1950 disturbance sent hydrogen from the sun to be seen in the spectrum of the aurora.

But where does the moon come in? When the daily magnetic variations are studied it is found that they are partly due to the moon, though not directly—rather through the tides that the moon raises in the ocean of air above us. These air tides are much larger than sea tides, having ups and downs of five kilometres at a height of one hundred kilometres. These influence the course of the electrical currents in the upper atmosphere and so alter the magnetic field on the earth.

In conclusion, Dr. Bartels expressed his gratitude for the hospitality with which he had been received here.

November 20, 1952—The meeting was held in the National Museum Lecture Hall. The president, after welcoming new members, called on Dr. Beals, who spoke briefly on the devoted career of the late Bernard Lyot, and of a fund organized by Mrs. Kuiper.

M. M. Thomson, of the Time Service of the Dominion Observatory, gave a talk entitled "Keeping an Eye on the Time". Needing no introduction to the members of the Ottawa Centre, Mr. Thomson is also well known to readers of the JOURNAL for his article on Canada's Time Service in vol. 42.

Mr. Thomson said he was one civil servant who was guilty of being a clock-watcher, but nowadays keeping an eye on the time is a very engaging task. Great advances have been made in the last few decades with the general use of crystal clocks and the introduction of new instruments for stellar observations. The pendulum clock beating out seconds has been replaced by the quartz crystal vibrating one hundred thousand times a second, making possible a more accurate subdivision of time intervals. The Dominion Observatory maintains three of these to ensure continuity of the time service, and others at the National Research Council and the Department of Transport are used to check one against another.

The uniform rotation of the earth on its axis is the primary standard of time-keeping, and formerly the astronomer corrected his clocks by observing the transits of stars visually. In the photographic zenith tube a photographic plate replaces the human eye, and precise crystal controlled machinery replaces the human hand in following the stars across the meridian. Both accidental and systemic errors have been reduced to such minute amounts as to render evident small irregularities in the rotation of the earth itself, and the wandering of the pole.

Mr. Thomson showed numerous descriptive and explanatory slides, and in conclusion, two movies were run; one taken at the Dominion Observatory thirty years ago; the second, a National Film Board Eyewitness film taken recently, served to contrast the new equipment with the old.

Dr. Millman, in thanking the speaker, paid tribute to the painstaking care which led to such accurate time-keeping.

December 4, 1952—The annual dinner meeting was held in the Experimental Farm cafeteria. Eighty-six members and friends enjoyed an excellent dinner. The president afterwards appointed scrutineers to examine the ballots for the annual election of officers. Members rose in tribute to Miss Ethel Steacy, a member of council whose death last summer was a loss to the Society. Secretary's and treasurer's reports were read and approved. Dr. Tanton announced the results of balloting; Miss M. I. Rettie of the Dominion Observatory was welcomed as the new member of council. The president indicated that an improved procedure in balloting would be considered for the next year's election when the general change of officers would occur.

He introduced the speaker, S/L K. R. Greenaway of the R.C.A.F. as a leading expert in Arctic aeronautics. After serving as radio and navigation instructor in the last war, he was attached to various research projects and made many flights over both geographic and magnetic poles, and holds the Thurlow award for outstanding contributions to the theory and practice of aerial navigation. His subject was "Weather in the Arctic".

S/L Greenaway said he was something of a parasite on astronomy; the Arctic navigator uses it, but does not contribute much to it. Neither was he a meteorologist, though a navigator must have a good working knowledge of the subject; he intended therefore to give a picture of Arctic weather from the flyers' and navigators' viewpoints.

The Arctic too has four seasons. In some locations, winter might be from November to April; spring from late May to June; summer, July and August, while autumn comes in September. Each season has its characteristic pattern of weather, which the speaker explained with the aid of maps of the main pressure systems of the Arctic throughout the year.

Many interesting points were made during the exposition. Sixty below zero temperatures are no more common in the Arctic than thirty below days in Ottawa. Many Arctic areas are as dry as Arizona, others have three hundred inches of snowfall. Hoar frost three or four inches thick sometimes forms on the sides of buildings. Ice crystal form is met with in cold windless weather; the slender crystals appear to hang vertically, allowing the flyer to see downward but blocking his forward view when he comes in to land. Striking pictures were shown of steam fog rising off open leads, like a hedge-row burning, over Hudson Bay. Others showed the huge 'ice islands' on which air and weather stations have travelled. In more southerly flights, stellar observations are used mostly for latitude, but in the far north, the navigator relies on them for azimuth as well. The results of scratching the perma-freeze cover were shown in summer photographs of pot-holed landing strips. Some islands have a cloud cover so persistent during the summer that their coastline cannot be mapped from the air. Sometimes the navigator uses icebergs as targets for his radar to get his ground speed and drift.

S/L Greenaway was warmly applauded at the conclusion of his talk, and thanked by Dr. Rose on behalf of the Centre.

R. W. Tanner, *Secretary.*

AT WINNIPEG

December 10, 1952—The annual meeting and the regular December meeting of the Winnipeg Centre, were held in the Grain Exchange Lecture Room at 8.15 p.m. December 10, 1952. Sixteen members were present. Mr. D. R. P. Coats occupied the chair.

Mr. Coats informed the meeting that he had visited with Dr. Gillson and Mr. Lockhart at the University. They had shown special interest in the Society and were quite willing to give us assistance whenever possible. Through the efforts of Dr. Gillson, Mr. Coats was fortunate in arranging for accommodation for our 1953 season. Room 214, Broadway Building, will be free to us for our Wednesday meetings until September 1953. The Society is especially grateful to Dr. Gillson for helping acquire this accommodation.

Mr. Coats proposed the following names for membership in the Society: Dr. E. H. S. Gillson, Mr. Robert J. Lockhart, Mr. Fred Zieler. Mr. Louis Habets, 475 William Avenue, who was proposed for membership in the Society at the last meeting was unanimously accepted as a member.

Reports of the treasurer, secretary and president were presented. Election of officers followed.

The President, Mr. D. R. P. Coats addressed the Society on the subject of "The Aurorae". Mr. Coats gave a vivid and brilliant description of his observation of the aurora borealis or northern lights. It was his excellent command of the English

language, his personal experience, and his studious enquiry into the subject which kept the group following his every word.

He cited ancient records and myths of the aurorae; of people believing it was the reflection of blood from some far-off battle field and other things just as fantastic. He then ventured into his own experience as a wireless operator on Ship Nascopie, giving details of the sight of the aurora, about 400 miles from the magnetic pole, stating that it was the most beautiful display he had ever witnessed.

He further referred to the observations of David Sarnoff, President of R.C.A., the streamers being deflected from the radio antenna of a ship on which he was a wireless operator. Mr. Coats had looked for this phenomenon but was unable to verify it.

Detailed description of the possible location of the aurorae, its effects on weather, its best locations for observation, the possibility of other planets having this phenomenon and much other information was given. Kodachrome slides of the aurorae and the various stages of lisplay were shown.

At the close of the address Mr. Coats was personally thanked by many members for his most interesting talk.

V. MARTENS, *Recording Secretary.*

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